

WHAT IS CLAIMED IS:

1. A method of forming a photonic crystal on a semiconductor substrate, the substrate having a receiving region, the method comprising the steps of:
 - forming a first layer of material over the substrate, the first layer of material having a first dielectric constant;
 - forming a second layer of material on the first layer of material, the second layer of material having a second dielectric constant;
 - repeating the forming the first layer step and the forming the second layer step a predetermined number of times to form a multi-layered structure with alternating layers, the multi-layered structure having a top layer and a plurality of underlying layers, the top layer having a top surface;
 - etching the top layer and the underlying layers to form a plurality of photonic stacks and a space between the photonic stacks, the plurality of photonic stacks having a plurality of top surfaces; and
 - forming a layer of interstack material over the substrate to fill up the space between the photonic stacks.
2. The method of claim 1 wherein the first layer of material is a dielectric.
3. The method of claim 1 wherein the layer of interstack material has a top surface that is substantially coplanar with the top surfaces of the stacks.
4. The method of claim 1 wherein the top surface of the layer of interstack material is above the top surfaces of the stacks.

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072219-0276281 (P05000)

5. The method of claim 1 wherein the top surface of the layer of interstack material is below the top surfaces of the stacks.

5 6. The method of claim 1 wherein the layer of interstack material is a dielectric having a dielectric constant that is equal to the dielectric constant of the layer of first material.

7. The method of claim 1 wherein the layer of interstack
10 material is a dielectric having a dielectric constant that is different from the dielectric constant of the layer of first material.

8. The method of claim 1 and further comprising the step of planarizing the layer of interstack material, the layer of interstack
15 material having a top surface.

9. The method of claim 8 wherein the first layer of material is a dielectric.

20 10. The method of claim 8 wherein the layer of interstack material has a top surface that is substantially coplanar with the top surfaces of the stacks.

11. The method of claim 8 wherein the top surface of the layer
25 of interstack material is above the top surfaces of the stacks.

12. The method of claim 8 wherein the top surface of the layer of interstack material is below the top surfaces of the stacks.

13. The method of claim 8 wherein the layer of interstack material is a dielectric having a dielectric constant that is equal to the dielectric constant of the layer of first material.

5 14. The method of claim 8 wherein the layer of interstack material is a dielectric having a dielectric constant that is different from the dielectric constant of the layer of first material.

10 15. A photonic crystal formed on a semiconductor substrate, the substrate having a receiving region, the photonic crystal comprising:
a plurality of spaced-apart photonic stacks formed over the receiving region of the substrate, the photonic stacks having top surfaces, each photonic stack having a plurality of layers of material that alternate between a first layer of material and a second layer of
15 material, the first layer of material having a first dielectric constant, the second layer of material having a second dielectric constant; and
an interstack material formed over the substrate between and adjoining the plurality of photonic stacks.

20 16. The crystal of claim 15 wherein the first layer of material is a dielectric.

25 17. The crystal of claim 15 wherein the interstack material has a top surface that is substantially coplanar with the top surfaces of the stacks.

18. The crystal of claim 15 wherein the interstack material has a top surface that is above the top surfaces of the stacks.

19. The method of claim 15 wherein the layer of interstack material is a dielectric having a dielectric constant that is equal to the dielectric constant of the layer of first material.

5 20. The method of claim 15 wherein the layer of interstack material is a dielectric having a dielectric constant that is different from the dielectric constant of the layer of first material.